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Case report
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RUPTURED ABDOMINAL AORTIC ANEURYSM AFTER ENDOVASCULAR REPAIR

RUPTURA ANEURIZME ABDOMINALNE AORTE NAKON ENDOVASKULARNOG LEČENJA

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Summary

Introduction. An aneurysm is a localized, permanent dilation of an arterial blood vessel with a diameter greater than 50% of the usual diameter for that aortic segment. It is treated with endovascular stent graft placement or open surgery. Endovascular stent grafting of the abdominal aorta has become popular as an elective treatment, but one of the complications is increased aneurysm diameter that may lead to rupture. **Case Series.** This case series reviews open reconstructive surgery of ruptured abdominal aortic aneurysms in three patients treated with endovascular repair. The diameter of the aneurysm increased due to endoleak or stent graft migration, leading to rupture. Due to the inability to extract the stent graft in two patients, the graft was transversely cut at the proximal part, where upper anastomosis was created using a Dacron graft prosthesis. **Conclusion.** Regular annual controls for the rest of patients lives are of great importance in order to avoid fatal complications after endovascular aneurysm repair. One of the methods after the abdominal aortic rupture after endovascular stent graft treatment that significantly shortens the duration of the surgery and gives a more stable upper anastomosis, is transverse stent graft cut in the proximal part. Complete prevention remains a challenge because a rupture may occur even if the abnormalities are not evident. The ultimate goal is to increase the survival rate after the ruptured abdominal aortic aneurysm.

Key words: Endovascular Procedures; Aortic Aneurysm. Abdominal; Blood Vessel Prosthesis; Postoperative Complications; Survival Rate; Vascular Grafting; Stents

Introduction

An aneurysm is a localized permanent dilation of an arterial blood vessel with a diameter greater than 50% of the usual diameter for that arterial segment. It is treated with endovascular stent graft placement or open surgery [1].

The main goal of treating abdominal aortic aneurysm (AAA) with surgical or endovascular repair is to reduce the risk of rupture and prevent the patient's death [1]. Endovascular aortic repair (EVAR) by stent graft placement is directed at removing the risk of rupture by its exclusion from arterial circulation [2].

Sažetak

Uvod. Aneurizma podrazumeva lokalno segmentalno stalno proširenje krvnog suda, sa svim slojevima, za više od 50% uobičajenog prečnika za pregledani segment i tretira se endovaskularnim stent-graftom i otvorenom hirurģijom. Endovaskularno lečenje aneurizme abdominalne aorte stent-graftom postalo je popularno kao elektivni tretman, ali jedna od komplikacija jeste dalje uvećanje dijametra aneurizme koje može dovesti do rupture.

Prikaz slučaja. Ovaj rad je prikaz otvorene rekonstruktivne hirurģije u slučaju rupture aneurizme abdominalne aorte kod tri pacijenta koji su u prvom aktu lečeni endovaskularno te se, zbog endolika i migracije grafta, dijametar aneurizme i dalje povećavao i završio se rupturom. Zbog nemogućnosti izvlačenja stent-grafta kod dva pacijenta, graft je transversalno presečen makazama na proksimalnom delu gde je naknadno kreirana gornja anastomoza interponiranog Dacron grafta. **Zaključak.** Redovne godišnje kontrole do kraja života pacijenata imaju veliki značaj kako bi se izbegle fatalne komplikacije nakon endovaskularnog lečenja. Jedan od načina nakon rupture abdominalne aorte nakon endovaskularnog tretmana stent-graftom, koji značajno skraćuje trajanje operacije i daje stabilniju gornju anastomozu, jeste da se poprečno preseče stent-graft makazama u proksimalnom delu. Kompletna prevencija ostaće izazov jer se ruptura može desiti i ako se abnormalnosti ne vide. Krajnji cilj je povećanje procenta preživljavanja nakon rupture aneurizme abdominalne aorte.

Ključne reči: endovaskularne procedure; aneurizma abdominalne aorte; vaskularna proteza; postoperativne komplikacije; preživljavanje; vaskularni graftovi; stentovi

Today, EVAR is a relatively safe and effective treatment of infrarenal AAA and it is considered to be the first choice therapy in patients with favorable morphology and poor health status unsuitable for open surgery. However, none of the currently available devices is completely effective in preventing rupture of aneurysm after EVAR [3], and it is also necessary to control these grafts and aneurysms for life. The goal of this paper was to substantiate this in regard to the occurrence of late ruptures.

Complications of endovascular repair include the appearance of endoleaks, stent graft migration, infection, and occlusion of the main arteries, which may increase the aneurysm diameter potentially leading to late rupture (**Table 1**) [4].

Abbreviations

EVAR	– endovascular aortic repair
AAA	– abdominal aortic aneurysm
CTA	– computed tomography angiography
DUS	– duplex ultrasonography scanning

Computed tomography angiography (CTA) has been considered a gold standard in check-ups after endovascular treatment of abdominal aneurysm, but a protocol incorporating annual duplex ultrasonography scanning (DUS) was introduced, and CTA was performed only if abnormalities were identified or DUS was not diagnostic [5].

The aim of this paper is to point to the importance of regular annual follow-ups to avoid fatal complications, as well options for the operative treatment of AAA rupture after EVAR that significantly shortens the duration of the operation and provides a more stable upper anastomosis.

We present three cases of successfully performed treatment of ruptured aneurysms of the abdominal aorta that were previously treated with EVAR, and because of insufficient monitoring and follow-ups, the diameter has increased and resulted in ruptured aneurysms.

Patient number I

The first patient, 78 years of age, was treated for AAA with an endovascular stent graft (EVAR - Medtronic Endurant) six years ago, and in the first two years he was followed-up, but then stopped coming by his choice. He had no other chronic diseases or allergies and did not take any medications. He was admitted to the emergency department, conscious, oriented, hemodynamically hypertensive with TA 160/100 mmHg, heart frequency - 70 min, and with good oxygen saturation of 98% SaO₂.



Figure 1. CT angiography of the abdominal aorta (Three-dimensional reconstruction) which confirmed the diagnosis of ruptured aneurysm of the abdominal aorta with a noticeable stent graft, and endoleak on distal and proximal anastomosis

Slika 1. Kompjuterizovana tomografska angiografija abdominalne aorte (Trodimenzionalna rekonstrukcija) koja potvrđuje dijagnozu rupture aneurizme abdominalne aorte sa uočljivim stent-graftom i endolikom na distalnoj i proksimalnoj anastomozi

He complained of a strong and sharp pain in the abdomen, followed by nausea 9 hours ago, and during the examination he presented with a painful abdomen with muscular defense and peritoneal suppression.

An emergency CTA (Siemens Somatom Sensation 16) was performed (**Figure 1**) which confirmed a ruptured AAA with the intraluminal presence of graft which corresponded to the stent graft and with the active extravasation of contrast at its distal end (type Ib endoleak) and less extravasation on the proximal end (type Ia endoleak).

The patient underwent xyphopubic laparotomy with intraoperative exposure of the abdominal aorta. A retroperitoneal hematoma was noticed. After the aneurysmectomy it was noticed that the stent graft was intact, the endoleak was on the proximal end on the posterior site, and the aneurysm rupture site was laterally to the left.

Because of the inability to extract the stent graft, it was cut transverse by scissors at the proximal part (**Figures 2A and 2B**) where the upper anastomosis of 20 mm Dacron graft prosthesis was created (**Figure 3**).

The swab which was taken from a graft was negative. A passive drain in the Douglas space was set. Intraoperative blood cell salvage of 1400 ml was done and 600 ml of autologous blood was returned. The operation lasted 100 minutes.

Postoperatively, the patient remained in the intensive care unit and after hemodynamic stabilization and transition to spontaneous breathing, on the fourth



Figure 2A. Intraoperative finding with infrarenal transversal intersected stent graft, the location of the planned proximal anastomosis of the Dacron graft prosthesis
Slika 2A. Intraoperativni nalaz sa poprečno presečenim stent-graftom infrarenalno, mesto planirane proksimalne anastomoze interponiranog Dacron tubus proteze

Table 1. Classification of endoleaks
Tabela 1. Klasifikacija endolika

Type/Tip	Origin of the leak/Poreklo endolika
I	Inadequate seal at proximal (Ia) or distal (Ib) end of the graft <i>Neadekvatno zatvaranje na proksimalnom (Ia) ili distalnom (Ib) kraju grafta</i>
II	Retrograde flow from the inferior mesenteric artery, lumbar arteries, other collateral vessels of the aneurysm sac/ <i>Retrogradni protok iz donje mezenterične arterije, lumbalnih arterija, drugih kolateralnih krvnih sudova aneurizmatске kese</i>
III	Component disconnection (IIIa) or fabric disruption (IIIb) <i>Diskonekcija komponenti endografa (IIIa) ili pucanje endografa (IIIb)</i>
IV	Graft material porosity/ <i>Poroznost endografa</i>
V	Endotension: increase of the prepressure without any visible evidence of blood in the aneurysm sac <i>Endotenzija: porast pritiska bez ikakvog vidljivog dokaza prisustvo krvi u aneurizmatскоj kesi</i>

day he was transferred to the Vascular Surgery Clinic. Because of high inflammatory markers (PCT 0.11 ng/ml, CRP 51 mg/L) as well as ALT (115 U/L) and AST (114 U/L), the patient was examined by an infectologist who prescribed antibiotic therapy and the markers normalized during hospitalization. Patient with palpable distal pulses, without any pain and mobile, was released home in good general condition on the 10th postoperative day with antibiotic (Levomax) and antiaggregation (Cardiopirin) therapy.

The last follow-up was done using DUS twelve months after surgery, and the patient was free of any pain, with a prosthesis and with palpable distal pulses.

Patient number II

The second patient 82 years of age, was treated for AAA with endovascular stent graft (EVAR -



Figure 2B. Stent graft extracted by transversal cutting the fixation site at the proximal part of the stent graft
Slika 2B. Izvađen stent-graft tako što je poprečno presečeno mesto fiksacije na proksimalnom polu stentgrafta

Medtronic Talent) eight years ago and for the first four years he was controlled, but then stopped coming for check-ups as advised by his physician. He suffered from a chronic obstructive pulmonary disease and hypertension, which he claimed to be under control. He was admitted to the emergency department conscious, oriented, hemodynamically hypertensive with TA 170/110 mmHg, heart frequency – 85 min and with good saturation of oxygen SaO₂ 99%.

An emergency CTA (Siemens Somatom Sensation 16) was made (**Figure 4**) which confirmed a ruptured AAA with intraluminal graft which corresponded to the stent graft. The graft was not in the proper place, it migrated distally.

Xyphopubic laparotomy was performed for exposure of the abdominal aorta. A retroperitoneal



Figure 3. Intraoperative finding with the interposition of a 20 mm Dacron graft
Slika 3. Intraoperativni nalaz sa interpozicijom Dacron tubusa 20 mm



Figure 4. CT angiography of the abdominal aorta (Three-dimensional reconstruction) confirming the diagnosis of ruptured AAA with the visible stent graft and its distal migration

Slika 4. CT angiografija abdominalne aorte (Trodimenzionalna rekonstrukcija) koja potvrđuje dijagnozu rupture aneurizme abdominalne aorte sa uočljivim stent-graftom i njegove migracije put distalno

hematoma was noticed. After the aneurysmectomy, it was noticed that the stent graft migrated distally, and that the aneurysm rupture was on the front site. After endostent graft extraction (**Figure 5**) interposition of 22 mm Dacron graft prosthesis was created. A passive drain in the Douglas space was set. Intraoperatively, blood cell salvage of 1000 ml was done and 350 ml of autologous blood was returned. The operation lasted 120 minutes.

The patient was postoperatively in the intensive care unit until hemodynamic stabilization and transition to spontaneous breathing, and on the eight day he was transferred to the Vascular Surgery Clinic.

The patient with palpable distal pulses and without any pain, mobile and in good general condition was discharged on the 15th postoperative day with antibiotic (Levomax) and antiaggregation (Cardiopirin) therapy. The patient died two months after the surgery due to cardiopulmonary insufficiency, without postoperative complications.

Patient number III

The third patient was 82 years of age and treated for aneurysm of the abdominal aorta with an endovascular stent graft (EVAR – Medtronic Endurant) 7 years ago and for the first three years he was controlled and then stopped coming by his choice. He suffered from hypertension, diabetes melitus, and had a coronary bypass surgery. He was admitted to the emergency department in a bad condition, with hypertension TA 160/100 mmHg, heart frequency – 100 min and with low saturation of oxygen SaO₂ 90%, non-communicative, in soporous condition.

He complained of strong and sudden abdominal pain followed by nausea about 1 hour ago, and the clinical examination showed a painful abdomen with muscular defense and peritoneal suppresion.



Figure 5. Completely extracted stent graft with all its parts
Slika 5. Kompletno ekstrahovan stent-graft sa svim njegovim delovima

The abdominal ultrasound was urgently done and it confirmed a ruptured AAA with intraluminal presence of the graft which corresponded to the stent graft. The patient was randomized as the first order of priority, and the indication for surgery was made without CTA.

Xyphopubic laparotomy was performed for exposure of the abdominal aorta. An intraperitoneal hematoma was noticed. After the aneurysmectomy, it was noticed that the stent graft was intact, and the aneurysm rupture was on the front site.

As in the first case, due to the inability to extract the stent graft, it was cut transversely through the proximal part where the upper anastomosis of 18 mm Dacron graft prosthesis was created. A passive drain in the Douglas space was set. Intraoperatively, blood cell salvage of 3400 ml was done and 1200ml autologous blood was returned. The operation lasted 130 minutes.

After the surgery, the patient was hemodynamically unstable with continuous vasoactive support in the intensive care unit. The patient died 6 hours after the surgery.

Discussion

The EVAR technique has progressed rapidly over the past 20 years. With an increasing incidence of aortic aneurysms revealed due to screening, improvements in detection methods and an increase in the older population worldwide, it is expected that the rate of EVAR will increase further in the future [6].

which means a higher incidence of ruptures after EVAR because it is one of the complications.

The less invasive procedure and generally satisfactory early results have made EVAR an attractive therapeutic alternative to most patients with elective AAA [5]. Studies comparing the outcome of EVAR with open surgery consistently showed a significant reduction in morbidity with endovascular repair, so the endovascular procedure has rapidly advanced [7]. Patients with ruptured AAA after EVAR are hemodynamically more stable compared to patients with de novo ruptures of AAA [8].

Although the future prospect of EVAR seems extremely bright at this point, identifying risk factors for unwanted events, such as a need for conversion to open surgery and late post-EVAR ruptures, can lead to further improvement of this technique [7].

The CTA is considered the gold standard after EVAR. However, its limitations include expenses, the risk of contrast-induced nephropathy and exposure to radiation [5]. We have a modified protocol which first involves a 6-month postoperative follow-up with CT scanning enhanced by contrast, later followed by a 12-month follow-up. If there is no endoleak and the aneurysm diameter is stable, then annual ultrasound examination of the aorta is proposed. Increased aneurysm or a new endoleak should encourage more intensive imaging and treatment if necessary. Dias and associates suggested a CT after the first, third and sixth postoperative months, and in the case of positive findings, CT should be done annually [9].

Van Marrewijk and associates published that endograft check-ups should be done using the following techniques: contrast enhanced computed tomography (in 84%), angiography (in 4%), magnetic resonance angiography (in 3%), duplex ultrasound examination (in 8%) every year [7]. In our hospital, during the first year, check-ups are done during 6 months, then only DUS and CTA annually if the results are satisfactory. The biggest problem in the world as well as in our hospital is that patients commonly stop coming for check-ups.

Large cohort studies reported rupture rates between 0.5 and 1.2% of patient per year after EVAR. In the literature, ruptures of AAA after EVAR occurred about 24 ± 18 months after surgery, whereas we had three cases after 8 years. The average age of these patients was 74 ± 8.6 years at the time of AAA rupture (range 56 - 93 years). Most were men, as well as in our patients. The mortality after ruptured AAA treated with EVAR is about 50%, which is lower compared to aneurysms untreated by EVAR, where the mortality is over 80% [6, 7, 9].

The increasing diameter of aneurysm is considered as an evidence of unsuccessful endovascular treatment. While other reports often use an increase of 7 mm in diameter on the CT as the growth threshold for 6 months [7], we consider 5 mm or more as a threshold indicating a significant change, that is 1 cm or more on annual basis.

Low back pain and/or abdominal pain in patients with an AAA is a sign of possible rupture and requires urgent diagnosis. It is much better to find that there is

no rupture intraoperatively, than to perform additional tests to create conditions for the rupture to really occur. If there is an AAA rupture (rAAA), more than half of the patients die before hospitalization [10].

Complications of endoleak, such as stent graft migration, stent fracture, dilation, or other aneurysms of the aortoiliac segment, require long-term follow-up of the patient, and secondary interventions are required in approximately 15% to 20% of patients, in most hospitals and in ours as well [3].

In previous studies, the authors pointed to the importance of follow-ups in the first two to three years [6], we emphasize the importance of regular check-ups to the end of life, due to the possibility of late rupture, which is lethal in most cases.

The failure of endovascular repair includes endoleak [7], stent graft migration [6], infection [11], and subsequent aneurysm enlargement, associated with permanent problems that may lead to late aneurysm rupture.

Fransen and associates reported cases of ruptured AAA after EVAR, where most patients were men of older age, caused by type I b endoleak, and in our patients both types of type I endoleaks were found [2].

Schloesser and associates reported that most ruptures of the AAA after EVAR were treated operatively, and that some of them underwent endovascular surgery. In our hospital, ruptures of the AAA are not treated by endovascular repair; that is the institution's policy because it is considered that immediate surgical treatment is an advantage and has better outcomes, which is also the attitude of many other countries.

Since rupture after EVAR is a relatively rare event, each rupture can offer enough new information to improve the monitoring and operational resolutions. So far, it has not been reported that due to the possible aneurysmal lesion after extraction of stent graft, it was cut out with scissors infrarenally and then implanted in proximal anastomosis. This provides faster setup of the clamps, shortens the entire surgery provides better stability of proximal anastomosis, avoiding the lesion and elimination of the wall of the abdominal aorta. The ultimate outcome is an increasing survival rate after aneurysm rupture.

The disadvantage of this case series is the small number of cases in our hospital, and in the next report the number of cases with this issue will be higher, since complications are inevitable and should be reduced to a minimum, which is the goal of this case series.

Conclusion

Regular annual follow-ups to the end of life are of great importance in order to avoid fatal complications after endovascular aortic repair. One of the methods after the abdominal aortic rupture after endovascular stent graft treatment that significantly shortens the duration of the surgery and provides a more stable upper anastomosis, is transverse cut of the stent graft with scissors in the proximal part. The ultimate goal is to increase the survival rate after the ruptured aneurysm of the abdominal aorta.

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